

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

REMARKS

In the present Amendment, the specification and the claims have been amended to replace “chain extender” with --amine chain extender, which is different from the polyol--. This amendment is supported by the specification at, for example, page 6, lines 20-25, and general knowledge in the art.

The specification and claims 18 and 35 have also been amended to recite --wherein the wt% is based on the total weight of compounds (a), (b), (c) and (d)--, and to replace “10-40 wt%” and “30-80 wt%” with --10 - about 53.1 wt%-- and --about 43.0 - about 81.5 wt%--, respectively. These amendments are supported by the specification, for example, Examples, particularly, Example 13 wherein the amounts of components (a) and (c) are 53.1 wt% and 43.0 wt%, and Example 3 wherein the amount of component (c) is 81.5 wt%. Applicants hereby present the weight percents for each component actually used in the Examples in the following table, for the Examiner’s consideration.

Example No.	Component (a) (wt%)	Component (b) (wt%)	Component (c) (wt%)	Component (d) (wt%)
1	22.1	4.6	72.2	1.0
2	22.2	4.6	72.2	1.0
3	12.1	5.2	81.5	1.1
4	24.6	6.0	68.4	1.0
5	28.9	2.9	67.2	0.9
6	32.5	5.0	61.8	0.7
7	25.6	5.4	68.4	0.7
8	42.0	6.6	49.6	1.8

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

9	38.7	12.8	47.8	0.6
10	40.7	10.1	48.0	1.3
11	39.2	7.0	52.3	1.5
12	49.9	2.2	46.3	1.6
13	53.1	2.0	43.0	2.0

The specification and claims 18 and 35 have further been amended to clarify the preparation process. This amendment is supported by the specification at, for example, page 3, lines 31-33; page 4, lines 1-4; and page 7, lines 9-12 and 25-30.

Claims 30 and 47 have been amended to delete the recitation of “-(CH₂CH₂O)-.”

Claims 18-34 have been amended to replace “aqueous polyurethane” with --aqueous polyurethane dispersion--. This amendment is supported, for example, by the Examples.

Claims 49 and 50 have been amended to be dependent from claim 35.

Claims 1-17 have been cancelled.

Entry of the present Amendment is respectfully requested. Upon entry of the Amendment, claims 18-50 will be all of the claims pending in the application.

In Paragraph No. 1 of the Office Action, claims 1-50 have been rejected under 35 U.S.C. §112, second paragraph, as allegedly being indefinite.

Applicants respectfully submit that claims 18-50 as amended are not indefinite for the following reasons.

Regarding claims 18 and 35, Applicants respectfully submit that it is inherent that the weight percents sum to 100 percent when the amounts of the components are selected.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

Regarding the bases for the weight percents, Applicants have in the Amendment, amended the claims to recite that the weight percents are based on the total weight of compounds (a), (b), (c) and (d).

Applicants have in the Amendment, amended the claims to explicitly recite an amine chain extender, which is different from the polyol (component (c)).

Regarding the recitation of “-(CH₂CH₂O)-” in claims 30 and 47, Applicants have in the Amendment, amended the claims to delete this recitation.

Regarding the NCO content recited in claims 18 and 35, Applicants have in the Amendment, amended the claims for clarity. Specifically, claims 18 and 35 each recites that the component (d) is added “under the NCO content of the aqueous dispersion between about 0.8-8.0 wt% through monitoring.” It is also described in the specification that the NCO content of the aqueous dispersion can be monitored closely, and the chain extender is added to chain-extend the dispersed prepolymer under the NCO content of the aqueous dispersion between a specific range, i.e., about 0.8-8.0 wt%.

Regarding the recitation of “aqueous polyurethane” in claims 1-34, Applicants have in the Amendment, amended claims 18-34 to replace “aqueous polyurethane” with --aqueous polyurethane dispersion--, for clarity.

In view of the above, the Examiner is respectfully requested to reconsider and withdraw the rejection.

In Paragraph No. 3 of the Office Action, claims 1-4, 6, 9, 11-21, 23, 26 and 28-34 have been rejected under 35 U.S.C. § 102(b) as allegedly anticipated by Coogan (US 4,801,644).

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

Applicants respectfully submit that the present claims as amended are not anticipated by Coogan for the following reasons.

In the present Amendment, Applicants have amended claim 18 to recite an aqueous polyurethane dispersion which is prepared by (A) first reacting (a) 10-about 53 wt% of an aromatic diisocyanate with (b) 1-15 wt% of a compound containing active hydrogen and a hydrophilic group or a group capable of forming hydrophilicity, to form a diisocyanate-terminated compound containing a hydrophilic group or a group capable of forming hydrophilicity; (B) then reacting the diisocyanate-terminated compound with (c) about 43-about 81 wt% of a polyol to form a prepolymer containing a hydrophilic group or a group capable of forming hydrophilicity, and optionally neutralizing the prepolymer; (C) dispersing the prepolymer in water to form an aqueous dispersion; (D) monitoring the NCO-content of the aqueous dispersion; and (E) chain-extending the dispersed prepolymer to obtain an aqueous polyurethane dispersion by adding thereto (d) 0.1-5 wt% of a chain extender, under the NCO-content of the aqueous dispersion between about 0.8-8.0 wt% through monitoring.

That is, component (a), (b), and (c) are reacted sequentially to product the prepolymer, and then the prepolymer is neutralized optionally, dispersed, and chain-extended in this order, resulting in a polyurethane dispersion having excellent performance. In particular, the NCO-content of the prepolymer dispersion is monitored closely while the prepolymer is dispersed in water, and the prepolymer is chain-extended under the NCO-content between about 0.8-8.0 wt%. The thus-produced polyurethanes have high molecular weights and excellent mechanical

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

properties. Moreover, a polyurethane film produced thereby generally exhibits tensile strength of above 320 kg/cm², and ultimate elongation of 320%.

Coogan discloses an aqueous polyurethane dispersion. As described in columns 1-5 and Examples, the aqueous polyurethane dispersion of Coogan is the reaction product of an unblocked isocyanate-terminated polyurethane prepolymer containing carboxylic acid salt groups and a dispersion with a chain extender, wherein the unblocked isocyanate-terminated polyurethane prepolymer is formed by reacting a polyisocyanate and a component containing active hydrogen in the presence of at least one polyol. Specifically, the unblocked isocyanate-terminated polyurethane prepolymer is neutralized, dispersed in water, and chain-extended at the same time. In addition, surfactants, such as N-95, and promotable water-soluble solvents, such as N-methylpyrrolidone, acetone or butyl ketone, are added in order to prevent the decomposition of the obtained aqueous polyurethane dispersion.

Applicants submit that there are fundamental differences between the aqueous polyurethane dispersion of Coogan and that of the present invention.

First, the preparation process and the configuration of the prepolymer of Coogan are different from those of the present invention. The present claim 18 recites a prepolymer prepared by reacting sequentially an aromatic diisocyanate, a compound containing active hydrogen and a hydrophilic group, and a polyol, instead of by reacting those simultaneously as disclosed in Coogan.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

It is well known in the art that simultaneous reaction leads to random copolymers, whereas a sequential-type reaction leads to block copolymers, as evidenced in Markusch (US 4,879,322), column 13, lines 28-33.

Accordingly, the configuration of the prepolymer used in the present invention is block, whereas the configuration of the prepolymer of Coogan is random. In addition, Coogan explicitly describes that the polyurethane prepolymer employed thereby is unblocked (claim 1). Applicants submit that the characteristics of polyurethanes obtained from prepolymers having different configurations are different.

Further, the present claim 18 recites an aqueous polyurethane prepared by neutralizing optionally, dispersing, and chain-extending the prepolymer sequentially, instead of neutralizing, dispersing, and chain-extending the prepolymer simultaneously as disclosed in Coogan. The thus-obtained aqueous polyurethane dispersion has improved storage stability and superior mechanical properties. It is not necessary to add surfactants and/or promotable water-soluble solvents to prevent the occurrence of decomposition and to increase mechanical properties of the aqueous polyurethane dispersion, as required for the aqueous polyurethane dispersion of Coogan.

Moreover, the present claim 18 recites that the NCO-content of the prepolymer dispersion is closely monitored, such that a chain extender can be added to the dispersion, under the NCO-content between about 0.8-8.0 wt%, before a drastic reaction between the terminal NCO groups and water. Thereby, a stable aqueous dispersion of a high-molecular weight polyurethane can be obtained.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

To the contrary, Coogan does not teach or suggest “monitoring the NCO-content of the aqueous dispersion closely,” or “adding a chain extender into the dispersed prepolymer to chain-extend the dispersed prepolymer under the NCO-content between about 0.8-8.0 wt% through monitoring”.

In view of the above, Applicants submit that the present invention is not anticipated by Coogan, and thus the rejection should be withdrawn.

In Paragraph No. 4 of the Office Action, claims 5, 7, 8, 10, 22, 24, 25, 27 and 35-50 have been rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Coogan in view of Markusch (US 4,879,322).

Applicants respectfully submit that the present claims as amended are not obvious over Coogan in view of Markusch for the following reasons.

Applicants submit that claims 22, 24, 25 and 27 which depend from claim 18, are not obvious over the cited references, for the same reasons above, because Markusch does not rectify the deficiencies of Coogan.

Applicants further submit that there are at least two main differences between the method of making an aqueous polyurethane dispersion as recited in the present claim 35 and that as disclosed in Coogan.

First, as noted by the Examiner, the sequence of the prepolymer preparing process between Coogan and the present invention are different. Specifically, the prepolymer as recited in the present claim 35, is neutralized optionally, dispersed, and chain-extended sequentially,

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

instead of being neutralized, dispersed, and chain-extended simultaneously as disclosed in Coogan.

Markusch discloses that “the order of addition of the compounds containing isocyanate reactive hydrogens in the sequential type reaction process is not critical; however, during the reaction of these compounds, it is especially preferred to maintain an excess of isocyanate groups in order to control the molecular weight of the prepolymer and prevent high viscosities.”

Applicants submit that this statement is merely an opinion of Markusch. Further, the description indicates that the sequence of adding polyol for preparing the prepolymer is not critical, under the excess of isocyanate groups, during the starting of the prepolymer preparation process.

However, the reaction sequence for preparing the prepolymer in the present invention is significant. According to the present invention, the prepolymer is prepared by first reacting an aromatic diisocyanate with a compound containing active hydrogen and a hydrophilic group or a group capable of forming hydrophilicity, followed by adding a polyol to carry out the prepolymerization reaction.

The thus-prepared prepolymer has the hydrophilic groups or the groups capable of forming hydrophilicity evenly distributed among the prepolymer chains, and terminal isocyanate groups, which are relatively hydrophobic, wrapped in the internal part of twisted prepolymer chains. Accordingly, the terminal isocyanate groups are less consumed when the prepolymer is dispersing in water, and the chain extension can proceed to increase the molecular weight effectively.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

Further, the sequences of neutralizing, dispersing, and chain-extending the prepolymer to obtain the aqueous polyurethane dispersion are different between Coogan and the present invention. As well known in the art, the sequences of neutralizing, dispersing, and chain-extending the prepolymer to obtain the aqueous polyurethane dispersion is critical both in theory and in practice.

Still further, in the present invention, the NCO content of the prepolymer dispersion is closely monitored, such that a chain extender can be added to the dispersion before a drastic reaction between the terminal NCO groups and water. Preferably, 0.1-5 wt% of the chain extender is added under the NCO content of the prepolymer dispersion between about 0.8-8.0 wt%. Thereby, a stable aqueous dispersion of a high-molecular weight polyurethane can be obtained. Specifically, the aqueous polyurethane dispersions of the present invention are generally stable at room temperature for over one year. In addition, because the polyurethane has a high molecular weight, a dried film produced therefrom generally exhibits excellent mechanical properties, for example, tensile strength of above 400 kg/cm², ultimate elongation of above 400%, and 100% modulus of above 80 kg/cm².

Neither Coogan nor Markusch, taken alone or in combination, teaches or suggests neutralizing optionally the prepolymer first, then dispersing the prepolymer in water to form an aqueous dispersion, and chain extending sequentially the above aqueous dispersion to obtain an aqueous polyurethane dispersion.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Appln. No. 10/000,220

More particularly, none of the cited references teaches or suggests monitoring closely the NCO-content of the prepolymer dispersion when the prepolymer is dispersed in water and the prepolymer dispersion is chain-extended under the NCO-content between about 0.8-8.0 wt%.

In view of the above, Applicants submit that the present invention is not obvious over the cited references, and thus the rejection should be withdrawn.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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